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APPLICATION
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Title: MOTION ACTIVATED FIREARM LASER SIGHT

SPECIFICATION

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MOTION ACTIVATED FIREARM LASER SIGHT

Cross-Reference to Related Applications

The present application claims benefit of U.S. provisional
5 application Serial No. 60/412,832, filed September 23, 2002, the
disclosure of which is hereby incorporated herein by reference in its
entirety.

Field of the Invention

10 The present invention relates to the activation of a laser beam
for a sighting mechanism.

Background of the Invention

A variety of light beam assemblies have been disclosed as
sighting aids for weapons. These assemblies are either mounted on or are

an integral part of the firearm. An illumination source is provided that projects a narrow beam of light in a direction parallel to the weapon's bore-sight.

When the light beam and bore-sight are properly aligned, the bullet or other type of projectile will hit on or very close to the location of the light beam on

5 the target.

Lasers are a preferred mechanism of generating light beams for sighting applications. Lasers can be focused into a narrow beam with a very small divergence angle, so that they produce a small bright spot on the target tens to hundreds of yards from the light source. As used herein the word

10 "laser" is intended to include any form of a collimated light source.

The control devices for activating and deactivating the laser sight may be located on various areas of the firearm such as on or near the handgrip, rifle stock, or located somewhere on the trigger guard, and are incorporated into the electronic circuit of the laser. These controls may be

15 switches, waterproof buttons, levers, latches, or slides, etc., however, they may prove to be awkward and be distracting to a user when the user has to activate the laser sight. For example, the user may have to use one of his/her gripping fingers to press an activating button. Thus, the impulse to pull the trigger, which normally is implemented without physical displacement of the

20 barrel, may impart an unexpected twist to the weapon when one of the gripping fingers has to hold or push a laser activator switch or button, thereby throwing the bullet off its intended course. This is particularly inconvenient to a user, such as a law enforcement officer, when suddenly confronted with a hostile and life threatening situation. The officer usually has to perform the

following four steps when using a conventional laser-aimed weapon: 1) draw the weapon, 2) activate the laser, 3) aim, and if necessary, 4) fire.

To bypass the manual activation of the laser sight, a tritium switch has been fitted into the trigger area of the weapon as described in U.S.

5 Patent No. 5,522,167. A vial containing the radioactive substance is mounted in the forward trigger guard housing and a photoelectric cell is mounted in the rear trigger housing so that it is aligned with the emission from the vial. Once the user picks up the weapon and places his/her finger on the trigger, the beam from the vial to the cell is interrupted and the laser sight module is
10 activated. The tritium switch could be installed on any firearm that has a trigger guard and trigger.

A mercury switch has also been incorporated into the laser's circuitry to alleviate a user's manual control of the laser sight as described in U.S. Patent No. 5,177,309. The mercury switch is located, in the case of a
15 pistol, in the handgrip of the firearm. The switch is responsive to the attitude of the weapon so as to be automatically activated, turns on the laser sight, when the weapon is leveled at a target, and deactivated, turns off the laser sight, when it is not leveled, e.g., when the firearm is substantially vertical in a belt holster.

20 Both the tritium and mercury switches eliminate an entire step from an officer's list of activities needed to bring his/her weapon into action against a perpetrator. These switches, however, include substances that raise health and environmental issues.

Summary of the Invention

The present invention provides a control system to operate a laser in a sighting system for detecting a target. The control system is integrated in the laser sight's electronic circuitry and activates the laser by producing an electrical signal. The signal is generated when the system senses vibrations caused by motion.

The above and other objects and advantages of the present invention will be made apparent from the accompanying drawings and the description thereof.

Brief Description of the Drawings

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is an illustration of a motion detector.

FIG. 2 is a circuit diagram of the circuitry included in the motion detector of FIG. 1.

FIG. 3 is a representative schematic of a motion detector in a laser sight's circuitry.

FIG. 4 is a timing diagram illustrating the electrical behavior of the circuitry of FIG. 2.

Detailed Description of the Preferred Embodiment

As noted in the Background section, many types of firearms have laser sights or modules either mounted on an exterior surface of the firearm or incorporated within the firearm itself. Some of these firearms have control buttons or switches to activate the laser sight on the exterior surface of the firearm. The user of the firearm has to manually activate the laser thus adding an extra step to fire the weapon which may be awkward in a hostile situation. Other firearms have automatic switches that eliminate the manual activation of the laser by the user. These switches, however, may pose health and environmental problems to the user and society as a whole. The present invention is a system that incorporates an environmentally friendly motion detector that activates a laser sight on a firearm, and allows the user of the firearm to more efficiently aim the weapon at a target.

The motion detector 10 of the present invention is shown in FIG. 1 which is described in U.S. Patent No. 5,612,670, and is expressly incorporated by reference herein in its entirety. The motion detector 10, also known as a mechanical shock detector, includes a printed circuit board 12 and optionally may be encased within a plastic housing formed of two halves 14 and 16. The housing halves may be secured together by an adhesive or by screws 19 that also allow the detector to be mounted on a firearm such as the bottom of a pistol grip or on a rifle stock. The circuit board 12 is preferably manufactured using surface mount technology, thereby minimizing the size of the motion detector 10. The circuit board 12 may be mounted in a

laser sight assembly for a firearm or when encased within a plastic housing elsewhere on or within the weapon itself.

The circuit board 12 includes a number of surface mounted components 18 such as resistors, capacitors, diodes, transistors, and an
5 integrated circuit containing four operational amplifiers, as is more specifically detailed in FIG. 2. Also included is a strip 17 of piezoelectric material, a light-emitting diode (LED) D4, and a potentiometer RP3. The circuit board 12 is integrated into the laser sight's electronic circuitry by connectors that are known to one skilled in the art. An example of such circuitry is shown in
10 FIG. 3.

The motion detector 10 activates the laser sight of the firearm by producing an electric signal produced by the piezoelectric strip 17. The strip 17 has piezoelectric crystals incorporated into its structure. The crystals generate a pulse of electricity in response to vibrations produced by motions
15 which are sensed by the circuitry on the circuit board. For example, in the present invention the motion detector 10 will activate a laser sight on a pistol, or any other firearm with a laser sight, when the weapon is raised by the user to a horizontal position to take aim at a target. As described more below, if this electrical signal exceeds a threshold (which is preset by adjustment of
20 corresponding potentiometer RP3), the circuitry on circuit board 12 activates the laser for a predetermined amount of time, for example from about 10 to 30 seconds.

Three terminals 20, 24 and 26 lead from the circuit board 12. These terminals are connected to a power supply, such as the battery 30 for

a laser, and a laser sight circuit. As discussed in more detail below, when a motion condition is triggered by circuit board 12, signals on these terminals relay the motion condition to the laser sight circuit. Furthermore, light-emitting diode D4 is illuminated while the laser is activated, thus providing a visual
5 signal of a motion trigger, which can be used during installation when adjusting potentiometer RP3 to select the appropriate threshold levels.

Referring to FIG. 2 and FIG. 3, the circuitry 13 on circuit board 12 of the motion detector 10 is configured for connection to a power supply such as is typically found to operate lasers. Power for the circuit board 12 is
10 obtained from the laser's battery 30 via connections to terminal 24 and terminal 26.

As illustrated in FIG. 2, a circuit 13 in accordance with principles of the present invention is configured for connection to and interaction with a laser sight assembly. In accordance with principles of the present invention,
15 terminal 20 is connected to the laser control 40. Inside of circuit 13, transistor Q3 is connected between terminal 20 and ground. When transistor Q3 is active, the corresponding terminal 20 is connected to ground, activating the laser sight circuit. When transistor Q3 is not active, resistor R20 pulls terminal 20 to the positive power supply voltage.

20 Transistor Q3 is activated by analog circuitry which processes electrical vibration signals produced by sensor 17, which may be for example a piezoelectric strip available as part number 10027941 from Amp, P.O. Box 3608, Harrisburg, PA 17105.

Sensor 17 is connected differentially across the input terminals of an operational amplifier 42. Amplifier 42 produces a low-pass filtered version 60 (FIG. 4) of the vibration signals from sensor 17 (low pass filtering is provided by capacitor C3 and resistor R5, the values of which, when
5 multiplied together, produce a time constant of approximately 3 milliseconds).

The filtered output of amplifier 42 is fed to the non inverting inputs of operational amplifier 46, which is wired as a comparator. The inverting input of amplifier 46 is connected to the wiper of potentiometer RP3. Thus, amplifier 46 compares the voltage of the filtered analog signal from
10 amplifier 42 to a threshold voltage which is generated by adjusting potentiometer RP3. If the filtered vibration signal from amplifier 42 exceeds the threshold, the output of amplifier 46 saturates at the positive supply voltage.

The output of amplifier 46 is not directly coupled to transistor
15 Q3; instead, the output of amplifier 46 is connected to a sample-and-hold circuit comprising two parallel diodes D5, a capacitor C7 and a resistor R19. Operational amplifier 48, which is wired as a comparator, compares the voltage of capacitor C7 at its inverting input to a reference voltage at its non inverting input; the reference voltage is generated by resistors R17 and R18,
20 which are wired as a voltage divider and produce a voltage of approximately one-sixth of the power supply voltage.

When the output of amplifier 46 is positive (indicating that the filtered vibration signal from amplifier 42 exceeds the threshold set by potentiometer RP3), capacitor C7 charges to a voltage near to the power

supply voltage. Because this capacitor voltage exceeds one-sixth of the power supply voltage, the output of amplifier 48 saturates at the power supply voltage. Amplifier 48 is connected to transistor Q3; thus, when amplifier 48 saturates at the power supply voltage, transistor Q3 is activated, triggering the
5 laser control 40 via terminal 20.

If the filtered vibration signal from amplifier 42 falls below the threshold set by potentiometer RP3, the output of amplifier 46 saturates at the ground voltage. In this situation, diodes D5 turn off, and therefore capacitor C7 remains charged near to the positive power supply voltage. Thus, even
10 after the filtered vibration signal falls below the threshold, amplifier 48 will remain saturated at the power supply voltage, and transistor Q3 will remain activated.

If, however, the filtered vibration signal remains below the threshold set by potentiometer RP3 for any period of time, capacitor C7 will
15 discharge through resistor R19. The rate of discharge is determined by the product of the values of resistor R19 and capacitor C7, and has a time constant from about 10 to about 30 seconds. Thus, if the filtered vibration signal remains below the threshold for longer than the preset time constant, capacitor C7 will discharge to a voltage less than one-sixth of the power
20 supply voltage. When this occurs, amplifier 48 will as a result saturate at the ground voltage, and transistor Q3 will deactivate and the laser will turn off.

The activation of the laser 22 may be controlled by a laser control switch 40 as illustrated in circuitry 23 in FIG. 3. When the control switch 40 is in the on position, the laser 22 is in a continuous state of

activation (continuously turned on) and deactivated (turned off) when the switch 40 is in the off position. When the switch 40 is in the auto position, the activation of the laser 40 is controlled by the motion detector 10. The laser 22 is activated when the motion detector senses a vibration that creates an electrical signal that exceeds a preset threshold and deactivated after a predetermined time period.

Referring to FIG. 4, in accordance with the forgoing, in response to mechanical shock producing a filtered vibration signal 60 from the piezoelectric strip 17 having a burst of large magnitude oscillation, the circuit of FIG. 2 will produce an electrical ground connection on line 20. (Trace 64 of FIG. 4 illustrates logically the state of the transistor Q3 which connects to the trigger 2 terminal 20. An active transistor state, during which a ground connection is being made, is indicated by a high or logic "1" value in the trace 64 of FIG. 4).

As can be seen in FIG. 4, trigger terminal 20 will be connected (via transistor Q3) to ground for a period beginning whenever the filtered vibration signal 60 exceeds threshold 52, and continuing until the filtered vibration signal 60 has not exceeded threshold 52 for a period of time previously set.

Other variations or embodiments of the invention will also be apparent to one of ordinary skill in the art from the above description. Therefore, various changes, modifications or alterations to these embodiments may be resorted to without departing from the spirit of the invention and the scope of the following claims.